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university." In general, however, the plan has been well received and the attendance is certainly gratifying. On the opening day 302 students had registered. Of these 235 were hospitants, 28 regular students, and 39 hearers.

WAGES AND INTEREST AS DETERMINED BY MARGINAL PRODUCTIVITY.

MR. PADAN'S energetic attack on my theory of distribution in the *JOURNAL OF POLITICAL ECONOMY* for March, 1901, raises one principal question and a number of secondary ones. A reply which should cite and answer all of the subordinate questions would have to be very extended. As a rule it is my preference to refrain from replying to criticisms until both my theory itself and the case against it shall have been more completely presented. There is taking shape a volume, the purpose of which is to afford a brief outline of the static laws of distribution thus far published, and also such an outline of dynamic laws, as is needed for completing the theory in its main features, and making it more fully interpret the facts of life. This work may meet a number of objections which have been urged against the static theory as it stands alone.

The present volume has indeed tried to describe the general nature of the dynamic forces which act in distribution and their relation to static forces. The sixth, twenty-fifth, and twenty-sixth chapters of the book are devoted largely to this subject, and a reading of them will remove a certain misapprehension which is likely to exist in the minds of those who, without having read them, have seen the concluding part of Mr. Padan's article. In this part, by way of criticism of my view, he states that "the rates of wages and interest at any time are the result of the play of dynamic forces," that "they enjoy no immunity from change,"¹ that "the determination of the rates of interest and wages is a fascinating problem, for the reason that it is a *living*, ever changing problem," etc. The implication is that I have treated these rates as though in actual life they were fixed and unchanging, and have forgotten that, as Mr. Padan says, dynamic forces "both dominate the actual rates and exercise control over that real but elusive center of movement, the so-called standard about which the daily rates are ever

¹ *JOURNAL OF POLITICAL ECONOMY*, vol. ix. pp. 189-190.

fluctuating.”¹ This sentence is a good abbreviation of what I have said on this subject. Whatever may be the shortcomings of my theory a neglect of dynamic elements in the problem to be solved is not one of them.

The chapters referred to may be trusted to make it clear that the description which Mr. Padan gives of a static state as “an instantaneous photograph of a dynamic period at any moment”² does not apply to the condition that is described in the work under criticism. The static level of the ocean would not, in my view, be well represented by an instantaneous photograph of the waves. Mr. Padan’s main contention, however, is not dependent on any issue concerning dynamic forces. He claims that the law of final productivity, as I have presented it, assigns to labor and capital, as static incomes, amounts which together must exceed the total product of industry. In a certain diagram I have represented this total product by an area and the amount of wages, under static conditions, as a part of this area, leaving a remainder which must equal interest, if the contention that a static adjustment leaves no profits to the employer and imposes no losses on him is, in fact, true. Mr. Padan asserts, first, that the area representing this remainder is not so drawn that, independently of the question of profits and losses, it must equal interest. It represents what is left in the *entrepreneur’s* hands after wages are paid, but the figure does not in itself show that the capitalist is destined to get this remainder. He asserts, secondly, that the amount assigned to wages in the figure is an exaggerated amount.

In a perfectly static state would wages and interest be accurately determined by the law of final productivity? As so determined would they together equal the whole product of industry? Would each of them be the leavings of the other? These are the essential questions at issue. My argument is an economic one and could be complete even if the diagrams which illustrate it were taken entirely out of the book. Moreover if diagrams were used, they might be confined to illustrating the direct action of the law of final productivity—the action which, in this case, fixes wages—and might omit all reference to the significance of the area which, in this case, is residual. There is no need of so drawing this area that, *from the manner in which it is drawn*, it shall appear that it must measure interest.

The conditions of the static state require that labor and capital

¹ P. 190.

² P. 187.

shall get the whole product of industry, and I do not understand that Mr. Padan denies this fact. The important part of his criticism is that which tries to show that my method of determining wages by a direct application of the law of final productivity gives an incorrect result, and that, when I use the same method in determining in a direct way the interest on capital, the result gained is again incorrect. This law of final productivity, as he thinks, exaggerates both of these incomes, and causes the sum of them, as thus determined, to exceed the whole product of industry. Of course, then, what is left after one is paid would not equal the other.

The theory under criticism runs thus: A unit of labor added to a working force adds a certain amount to the product that is created, and under perfect competition, and in the absence of all the changes and disturbances which characterize a dynamic state, it would get, as its pay, the amount of this addition. Every other unit of labor would receive a like amount. In a corresponding way a unit of capital added to a productive fund would add a certain amount to the product, and under the same conditions of perfect competition and the absence of disturbing elements, would get this amount as its share of interest. Every other unit of capital would get a similar amount. Wherever, if after paying all wages and interest *as thus determined* the employer should find that he had a profit remaining, or that he had suffered a loss, it would be an indication that the perfect static adjustment which is postulated in the theory had not been made. Mr. Padan's claim is that if wages and interest were actually determined in this way they would call for sums that would impose a loss on the *entrepreneur*, since they would take from him more than the industry would bring in; and he has used the diagram that illustrates the principle of final productivity in trying to establish this claim. By making the final increment of labor and that of capital large he obtains areas representing wages and interest which, taken together, exceed that which represents total products. He shows that if we construct a diagram in such a way as to represent the force of labor as divided into five increments, test the product of the last increment in the way that is proposed in my book, and then multiply the result by five, in order to get the product of the entire working force, we shall get a result that is larger than it would be if, in making the test, we divided the force into ten increments. Five times the apparent

product of the fifth increment is a larger amount than ten times the product of the tenth increment.

If, in like manner, we test the productivity of the capital by dividing it into five equal portions, ascertaining the amount that is apparently due to the fifth increment, and multiplying that amount by five, we shall get a total quantity that is larger than it would be if we divided the capital into ten parts, measured the product that is due to the presence of the tenth part, and multiplied this amount by ten. The two totals obtained by tests in which, on the one hand, a large final increment of labor is used, and on the other, a large final increment of capital, make together a grand total that is appreciably excessive, since it obviously exceeds the total product of the labor and the capital.

If the mathematical study had been carried farther, it would have shown that the amount of the excess of apparent wages and interest over total products varies directly with the size of the increments of labor and capital used in making the tests. If we made them equal to the whole amounts of labor and capital, we should attribute the entire product first to labor and then to capital, and the sum of the two incomes would be twice the product. As the increments are made smaller, the excess of the two incomes over products becomes smaller, and it practically vanishes when minute increments are used. A hundred times the product of the one-hundredth part of the working force plus a hundred times the product of the one-hundredth part of the capital would exceed the total product by a very minute amount; and if we used the thousandth part of each agent in making the tests, the result would give as near an approach to the utmost conceivable accuracy as an economic law ever needs to attain.

The truth to which Mr. Padan's reasoning would, if it were completed, lead is that in any application of the general principle on which the theory of value and the theory of distribution rest, which may be called the Law of Final Economic Efficiency, minute increments of the agent whose efficiency is testing need to be used. The law of final productivity of labor and of capital is one phase of the more generic principle, and the law of final utility of goods, on which market values depend, is another. If, in gauging the selling price of the supply of wheat, we withdrew a fifth of it, ascertained what the public would pay rather than be deprived of this amount, and inferred that the market price of the whole supply would be five times that amount, we should be gravely misled. Our estimate of the total value

of the wheat would be greatly exaggerated, and it would become accurate in proportion as we reduced the size of the increment the utility of which is the basis of valuation. Accurate estimates of the productive power of labor and capital also require the use of small increments, and in this case the approach to mathematical exactness which is made, as the increments are reduced, is more rapid than the reduction of the increments. A continuation of the graphic study would reveal this fact, since it is connected with the form of the productivity curves. Take the product of the one-thousandth part of the labor and multiply it by a thousand, and you get an amount that may not exceed the true product of all the labor by a millionth part. Get an equally accurate measurement of the product of the capital and add this to the amount which the former measurement gives as the product of the labor, and the sum will exceed the output of the industry by a sum that is as near to a mathematical zero as is necessary for any end theoretical or practical. If, for any purpose, the remaining nearly infinitesimal variation were of importance, it should be noted there are mathematical ways of eliminating it.

When in measuring the product of the labor, we use a large fractional part of the force as the basis of the test we get, as the product of this exaggerated increment, a quantity that includes, besides the true product of this labor, a certain excess, and this excess is, in reality, a part of the product of capital. So also in measuring, in a like way, the product of an exaggerated increment of capital, we get an excess that really is a part of the product of labor. Calculating either of the totals on this basis gives as the seeming product of one of the two agents an amount that equals that product plus a moiety of the product of the other agent. Add these totals and of course the sum exceeds the joint product of the two. The equation that we can legitimately make stands thus: The product of labor plus a part of the product of capital, if added to the product of capital plus a part of the product of labor, gives a total which exceeds the joint product of the labor and the capital. By reducing the size of the increments used in applying the tests to small dimensions we make the excess microscopic. On this point and all the minor ones to which Mr. Padan's article refers, I rely on the verdict to which a careful study of the theory itself will lead.

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